

Influence of low temperatures on human organism

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Influence of high temperature

Introduction: Thermoregulation

Thermoregulation is a term which describes the phenomena that the human body temperature stays constant independent of temperature changes in the environment. A section of the brain, which is called hypothalamus, controls the thermoregulation. The Hypothalamus sends signals to the organs, muscles, glands, and nervous system when it senses that the internal temperature is becoming too low or too high. The thermoregulating mechanisms in the human body including the Hypothalamus are supposed to keep the internal temperature at 37 °C. The range of the temperature of a healthy human is narrow, it is only between 36,4 °C and 37,8 °C. If the temperature drops below 36 °C the human might suffer hypothermia, which involves several symptoms and can also causes death. On the other hand the temperature can get too high. The body reacts to that by

- sweating and
- vasodilation (Vasodilation describes enlarged capillaries which increase the blood flow at the skin surface so the body can release heat through radiation.)

On the contrary a body affected by hypothermia tries to produce heat or increase heat loss by

- stopping to sweat,
- Vasoconstriction (Vasoconstriction means that the capillaries constrict, or become more narrow to decrease the blood flow under the skin and reduce heat loss),
- Thermogenesis (Thermogenesis describes heatproduction through organs, muscles [by shivering] and also the brain) and
- Hormonal thermogenesis (Hormonal thermogenesis means the activation of thyroid gland to release hormones that increase metabolism which rises the amount of energy the body creates and the amount of heat the body is able to produce.)

Hypothermia

Hypothermia is the state of a body of a living organism after cold exposure. When the heat loss has been greater than the heatproduction over a long time, the core temperature drops below 35 °C, which causes the normal bodyfunctions and metabolism to not work sufficiently. Hypothermia causes a lot of health issues and can lead to death. Hypothermia can be divided into three stages based on the internal temperature:

1. Stage: Mild Hypothermia ->35°C-32°C

- Constant shivering
- Tiredness
- Low energy
- Cold or pale skin
- Fast breathing (hyperventilation)

=> The body tries to keep the temperature constant. The blood vessels will become narrow, causing the outer bodyparts to be less supplied with blood (centralization).

2. Stage: Moderate Hypothermia -> 32°C-28°C

- Being unable to think or pay attention
- Confusion
- Loss of judgement and reasoning (Someone with hypothermia may decide to remove clothing despite being very cold)
- Difficulty moving around
- Loss of co-ordination
- Drowsiness
- Slurred speech

- Slow, shallow breathing (hypoventilation)
=> The person usually stops shivering completely. This is a sign that his condition is getting worse.

3. Stage: Severe Hypothermia -> below 28°C

- Unconsciousness
- Shallow or no breathing
- Weak, irregular or no pulse
- Dilated pupils

=> The person appears to be dead. Most of the time the pulse cannot be felt .

Further description of the course of Hypothermia

If the temperature of the body sinks below approximately 35 °C, the main aim which is lead by the hypothalamus, the gland in the brain that acts as the body's thermostat, is to keep the core temperature high enough to protect the organs from loosing their functionality.

Firstly blood vessels start to narrow (vasoconstriction) to prevent the body from loosing too much heat. In addition the circulation of the blood concentrates on the core and the blood circulation in the extremities decreases (Centralization). Unfortunately these measurements lead to an increase of blood pressure, because the heart faces a higher resistance. As a consequence the person, especially people who already suffer from high blood pressure (hypertension), can feel dizzy, sick or even get nose bleeding. Furthermore the decrease of blood in the extremities causes the risk of them to go numb and ending as frostbites. Mostly this happens to toes, fingers and the nose. Another consequence of vasoconstriction is that the heart frequency increases and ends up as rapid and excessive. This causes the heart to work less efficiently, provide less blood flow to the rest of the body and the respiratory rate increases.

If the body temperature keeps going down the heart frequency keeps rising and the heart keeps providing lesser blood flow. As a consequence the brain soon has to face a lack of oxygen, heat and blood. Which leads on the one hand to unconsciousness and on the other hand to a problem with breathing and the circulatory system. The body stops moving and is basically unprotected against the growing hypothermia.

Problems with breathing and the circulatory system lead to an irregular heartbeat (cardiac dysrhythmia). At last the whole circulation and respiratory system stops working and the body falls into a suspended animation and finally dies.

Usage of low temperature in medicine

- specific operations, such as organ transplantation

→ the body temperature will be artificially decreased

→ the organ is also stored in a cold environment

- storage of stem cells, bone cells and cornea cells

→ embedded in liquid nitrogen

→ metabolism will be completely stopped

→ difficult and complex process of freezing and unfreezing

- storage of red cell concentrate (RCC)

→ can be stored up to 40days in a 4 °C cold environment

→ if the temperature is below or above 4 °C, the time in which RCC can be used for transfusion, decreases rapidly.

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